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# ENCRYPTION

- Homomorphic encrypted data can be used for only simple operations like addition and multiplication. So can't train ML models using this.

# AES ENCRYPTION

- AES (Advanced Encryption Standard) is a symmetric encryption algorithm that securely encrypts and decrypts data using the same secret key.
- AES encryption produces ciphertext that looks like random bytes and has no mathematical relationship to the original data.
- Encrypted data can't be used for training or inference of ML models, without decrypting.

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# AES ENCRYPTION

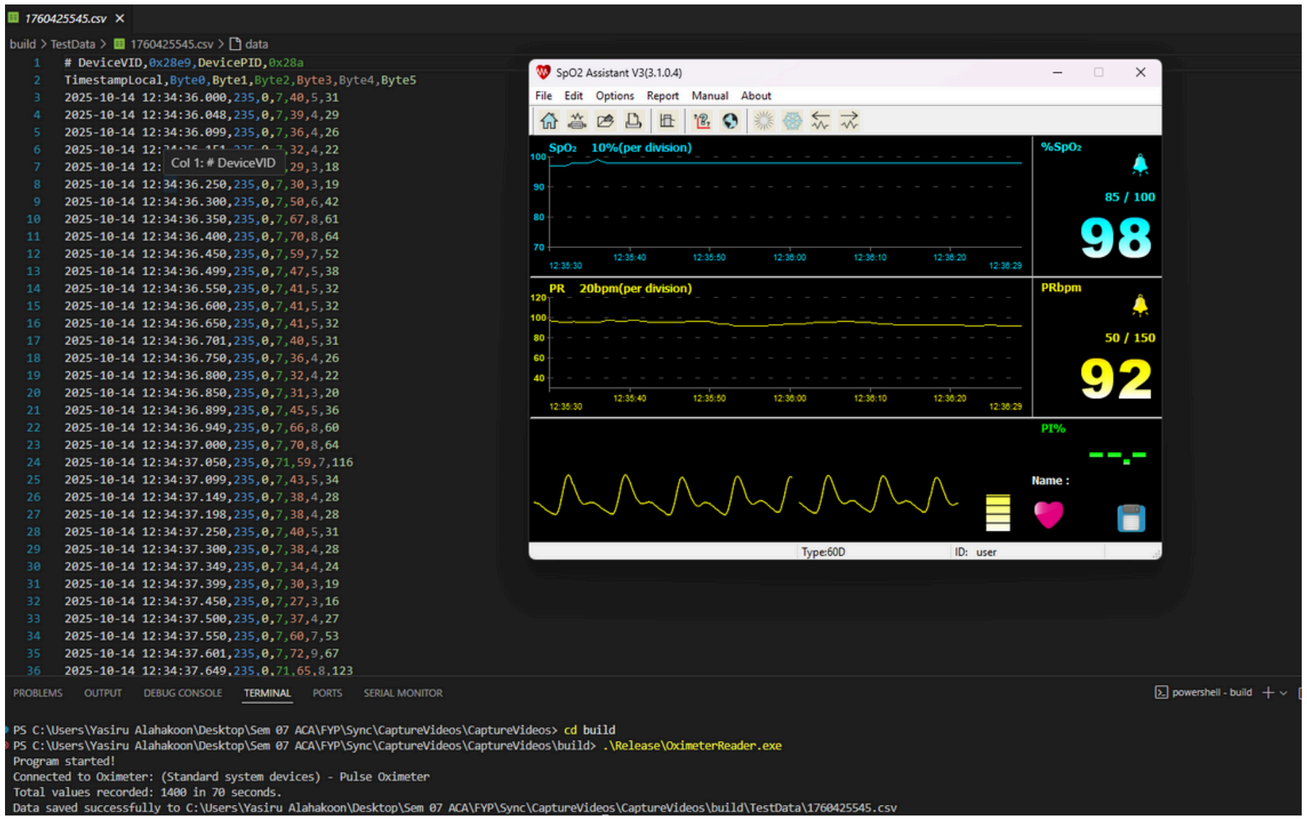
```
(encrypt) C:\Users\ASUS\Downloads\encryption>python aes_encrypt.py
Encryption complete in 17.63 seconds. Save this key to decrypt: fd1886661c9a63ce5c61de68e611baea

(encrypt) C:\Users\ASUS\Downloads\encryption>python aes_decrypt.py
Enter the 32-character hex key used for encryption: fd1886661c9a63ce5c61de68e611baea
Decryption complete in 10.39 seconds. Output saved to decrypted files\test4_decrypted.mp4
```

- encryption - around 20 seconds
- decryption - around 10 seconds
- encrypt-decrypt cycle - around 30 seconds

videopulse video-
1 min 9 seconds  1.8GB

# Synchronization of Pulse Oximeter Readings with Video




**Last Week:**

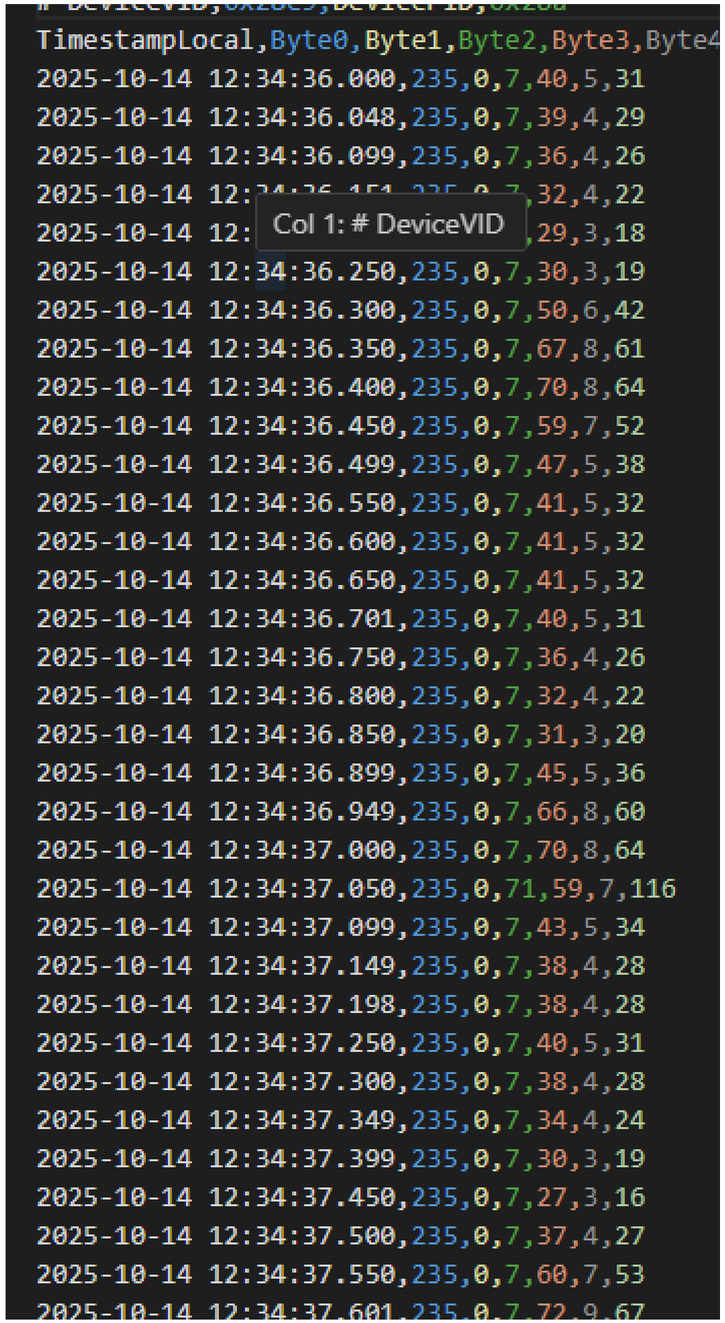
I was unable to connect the pulse oximeter to obtain real-time data.

**This Week**:

I successfully connected the pulse oximeter and started receiving real-time data. Initially, even when connected, the device did not transmit data because it requires an initial hand movement to begin transmission. Once this was done while the software was running, I was able to receive the pulse oximeter data successfully.

**Synchronization**

The system now supports synchronization between the pulse oximeter data and the mobile camera video feed, enabling aligned analysis. In the previous implementation, each pulse oximeter timestamp was aligned with the corresponding video frame for synchronization.




- The pulse oximeter transmits data packets of 5 bytes. However, the manual does not provide an official decoding algorithm to extract parameters such as pulse rate, heart rate, or $SpO_2$. Based on last year's group work, byte 3 was interpreted as a PPG signal value. This byte represents values in the range 0–255, which need to be mapped correctly to obtain the real measurement range. I am still analyzing their method to understand the reasoning behind this approach.

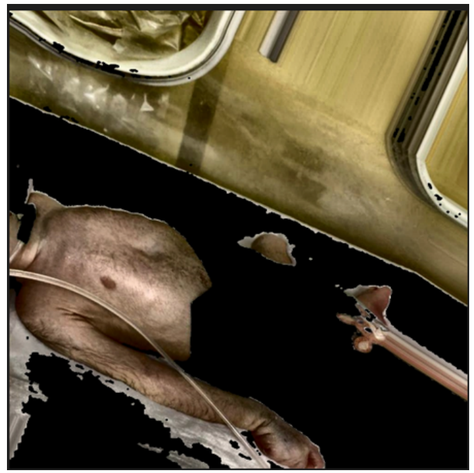
- Nevertheless, we can follow a similar procedure to synchronize the pulse oximeter readings with the mobile camera video, just as the previous group did with a webcam.

Section 7.1 (Page 37): "Real-time data transmission algorithm"
*"**The data transmission method is determined according to the range of physiological parameters generated by the device.**"*

# Skin Segmentation and Jaundice Detection

**Skin Segmentation with U-Net ("Skinny")**

- Implemented a lightweight U-Net model for skin detection and segmentation.
- Model: "Skinny: A Lightweight U-Net for Skin Detection and Segmentation" (**GitHub: 123mpozzi/skinny**)
- Designed for general human skin — adapted for infant skin segmentation.
- Model weights used & retrained on our dataset for improved performance.



**Observation**:

- Segmentation worked but not perfect — some baby skin regions were missed or over-segmented.
- Likely due to lighting, color variation, and different infant skin tones.
- **Future work: retrain or fine-tune with baby-specific data.**

# ROI EXTRACTION - DATASET

**Dataset Split**

| TRAIN SET 88% | VALID SET 8% | TEST SET 4% |
|---|---|---|
| 663 Images | 63 Images | 31 Images |

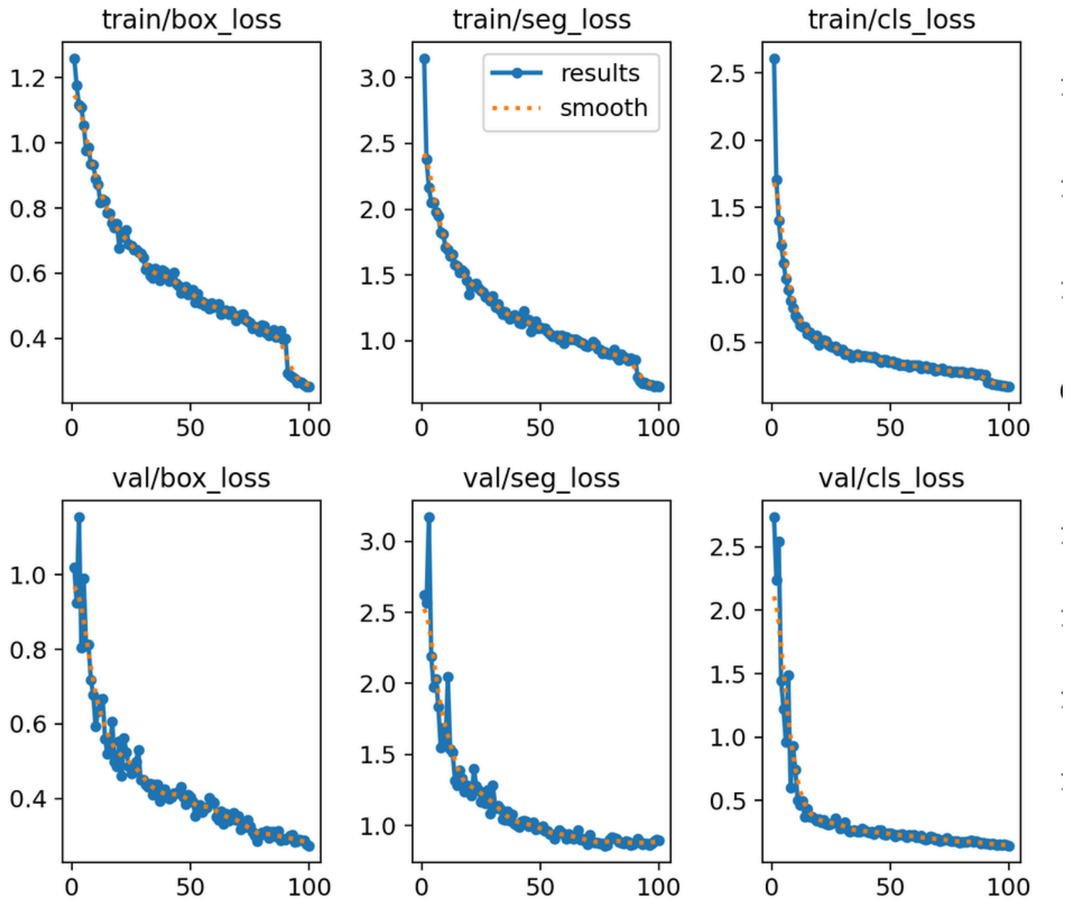
**Preprocessing**

Auto-Orient: `Applied`
Resize: `Stretch to 640x640`

**Augmentations**

Outputs per training example: `3`
Flip: `Horizontal`
90° Rotate: `Clockwise, Counter-Clockwise, Upside Down`
Rotation: `Between -15° and +15°`
Saturation: `Between -25% and +25%`
Brightness: `Between -15% and +15%`
Exposure: `Between -10% and +10%`

# ROI EXTRACTION - TRAINING




| | Training | Validation |
|---|---|---|
| **Box Loss** | 0.2517 | 0.27321 |
| **Seg Loss** | 0.65422 | 0.89713 |
| **Class Loss** | 0.16978 | 0.14533 |

- Base model: YOLOv11
- Epochs: 100
- Learning rate: 0.01
- Batch size: 16

# ROI EXTRACTION - VIDEO

- Video from the NBHR dataset that are completely unseen by the model.


- Issue : large processing time
- Possible solution : Detect the face in first frames and track the region using tracking method

# SPO2 ESTIMATION

- **Beer–Lambert law - Oxyhemoglobin ($HbO_2$) absorbs more IR, less red**
  **Deoxyhemoglobin (Hb) absorbs more red, less IR.**

- $$R = \frac{(AC_{red} / DC_{red})}{(AC_{IR} / DC_{IR})}$$

$$SpO2\ value = A - B \times R$$

*(A and B are empirical constants)*